uary issue, the JOURNAL discussed the matter and pointed out the well-known fact that through the aid and assistance of complacent congressmen, the U. S. Government is mulcted of about $30,000,000 annually, which sum is overcharged by the railroads. If the roads received for carrying mail matter exactly what they receive for identical hauls of express matter, Uncle Sam would save thirty million dollars a year. This is bad enough, in all conscience, but it is not the limit of petty crime to which our "honorable" congressional representatives, the servants of the corporations, have gone. For years almost without number, it has been a notorious scandal that during the time when the government mail weighing was in progress, tons of public documents, seeds, speeches about matters in which nobody is interested, and indeed any and every old thing that may be franked, and even, sometimes, matter on which postage is paid, is sent through the mails, merely to increase the weight and thus increase beyond an honest limit the amount which the government shall pay to the railroads. Watch out, during this month of October, and see whether your very kind and thoughtful representatives in Congress do not send you, without your solicitation,. public documents, seeds, etc., that you do not want and which but help the railroads to rob the country. In the January JOURNAL this subject was touched upon, and we then said:

> "In one month when the mails were being weighed, a single physician in San 'Francisco was favored with three sacks of government publications, weighing probably two hundred pounds."

If you are gratuitously and unaskingly presented with any such matter during this month of October, just remember the reason for it—and see that you let your thoughtful representative in Congress know that you know it. There is really no remedy quite so effective, in the treatment of crooked or distorted legislators, as letting *them* know that *you* know exactly all about it, and why.

INFANT FEEDING.*

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The problem of infant nutrition is largely one of physiological chemistry, and too often we approach the subject without grasping the extent and complication of its equation. Some of the terms are obscure and others seem insignificant and are easily overlooked, the more so, because we are prone to forget that digestion is but a small part of the nutritive cycle and that it must fail if utilization of the digesta is incomplete or if the food contains fewer nutritive units than the child's economy demands.

Thanks to the Munich school of physiologists, we have fundamental data that make the accurate determination of nutritive demands an easy matter. We are fortunate, too, in that the simple composition of milk renders the task of determining its caloric value light. Few today doubt that cow's milk, though imperfect, is the most suitable basis for nutritive mixtures, nor that a knowledge of the principles of Rotch's percentage feeding plan is as essential to the prescriber of foods as is a knowledge of weights and measures to the prescription writer. However, percentage modifications were designed primarily to meet the exigencies of digestion. Built up from cow's milk in elaborate imitation of mother's milk, they fail to reproduce the essentials and have rarely brought full satisfaction to those who use them. Of late there has been a tendency to take up the Continental system, which proposes that we shall determine the food value for infants as we do for adults, in the only accurate way, by a consideration of caloric values. Some of the recent advocates of this system are amusing; they plead for its adoption as though they had found a panacea for all of childhood's ills. One author in particular lectures American pediatrists for their stiff-necked adherence to the outworn percentage plan, which according to the sapient writer, ro European pediatrist would deign to consider. Such papers show a failure to grasp the principles underlying either plan; for the two are in no sense conflicting, on the contrary they are complementary.

This paper is an atempt to show: 1—That the percentage plan alone cannot always be relied upon; 2—That the caloric plan, alone, cannot always be relied upon; 3—That the best results in infant feeding are to be had by a judicious combination of the two plans; that is to say, by determining the needs of the infant in calorics and presenting a food containing the equivalent number of calories with a percentage composition suited to the digestive capacity of the particular infant.

On a separate sheet which has been distributed I have attempted to give a simple method for arriving at percentages in terms of dilution and for determining the caloric value of percentage mixtures. The advantages of the percentage plan are: 1—It makes quantitative accuracy possible; 2—It leads to the consideration of the relative digestibility of fats, carbo-hydrates and proteids; 3—It tends to impress the necessity of regular feeding upon the mother; 4—It tends to impress the value of cleanliness upon the mother, and therefore its educative value is great.

The advantages of the caloric system are: 1—It informs us of the food necessities per pound of child; 2—It informs us that the necessities of children of the same weight differ; thin children lose more heat and need more food than fat ones, quiet or sick children lose less heat and need less food; 3—It informs us in exact terms of the nutritive value of foods and enables us to allow by increasing the caloric value of the other food ingredients, for the fact that the digestion of cow's milk albumen takes more enerꝋv than the digestion of the albumen of human milk.

The disadvantages of the caloric method are: 1—It takes no cognizance of digestion. A mixture

of cow's milk of proper caloric value may be utterly indigestible. Such a mixture would demand re-adjustment of percentage composition in order to maintain the child in health; 2—It is essentially a doctor's method and has little educative value for the mother as it is a matter of applied physiology; 3—It gives no guide to the proteid or fat necessities of the child. A child at six months needs approximately 14 grammes of proteid, 30 grammes of fat and 59 grammes of carbo-hydrate, amounts which properly breast-fed children of that age receive in 24 hours.

The chief disadvantage of the percentage method is its failure to provide a definite measure for nutritive as opposed to digestive needs. Most of its minor disadvantages are really not inherent in the method, but are abuses of it. The mathematical minded pediatrist has walled it about with unnecessary formulæ till too often it has come to appear a problem in higher mathematics. Then, too, the ease with which proportions of ingredients can be varied has led many astray. With their minds fixed ·only on increase or decrease of percentage composition they have overlooked the fact that there are many causes for curdy stools other than too high proteid concentration—a matter I shall discuss more fully later.

The advantages of the combined percentage and caloric methods are: 1—It considers both the digestive capacity and the nutritive needs; 2—It is simple; 3—It is flexible;—one can lessen the percentage of, say proteid, to meet the emergencies of digestion and increase the percentage of sugar to a degree that will exactly supply the calories lost by the abstraction of the casein; 4—It is accurate. We have but to remember that a child will lose weight on a daily ration that supplies less than 30 calories to the pound; that in the first three months a normal plump baby should have at least 45 calories per pound; in its second three months 40; the second half year 36. Also it is important to recall that an atrophic baby will require food to supply daily 50 calories per pound.

The work of Budin and Variot and Levin has shown us that clean milk can be fed in very high concentration provided that the caloric needs of the infant are considered and that not much more milk is fed than will supply these needs. For instance, a six months old child, taking its litre of milk (equal to about 580 calories) in five feedings during the 24 hours, will digest it equally well whether it be given in 5½ ounce feedings of straight milk or eight ounce feedings of 50 per cent dilution. This work has demonstrated that from 2¾ to 3½ per cent of proteid in mixtures made from sterile milk is tolerated in France by even young infants; then why is it that in this country we have difficulty in getting babies to digest ¾ to 1½ per cent proteid? Why do we so frequently find curdy stools passed by children who are taking such low proteid concentrations? There are very many reasons, more than we have time to discuss. The commonest are: 1—Unclean milk; 2—Interference with

proteid digestion by fat; 3—A fat or carbo-hydrate food content which is insufficient to provide proper digestive energy and heat. This is especially the case in wasted babies; 4—Such excess of fat starch, or, rarely, sugar as to produce indigestion; 5—An insufficiency of sodium salts in the mixture. (Rapid feeding and the presence of preservatives in milk.) I cannot speak for other cities of this State, but it is a reflection on the intelligence of San Francisco that there it is practically impossible to obtain clean milk. Examination of samples from various dairies has in no instance yielded less than one million bacteria to the cubic centimeter. More often a million and a half have been found and in a number of instances the bacteria of fecal contamination have showed exceedingly high. The conditions of milk delivery, too, are vicious; open wagons and dirty streets offering every facility for infection. Moreover, the average time between milking and delivery is eighteen hours. To this must be added another eight hours' delay for those consumers who have to buy their milk from groceries, bakeries and small retailers. The rapidly increasing acidity of contaminated milk is a well established fact which coupled with what we know of the action of acid on casein will many times explain the appearance of curds in the stools and malnutrition in the infant.

The work of Hart and Van Slyke has shown the casein of milk to exist as a loose chemical compound with calcium, called calcium casein, which on entering the stomach is modified by renin to become calcium paracasein, what we in homely phrase call junket. The difference between the two bodies is probably a physical one only. This junket or calcium paracasein, under the influence of a small amount of free HCl in the stomach, loses its calcium and becomes free paracasein. A still further amount of free HCl forms an acid compound of paracasein, paracasein hydrochloride by name, and these paracasein compounds are in the inverse order physically unstable and correspondingly digestible. On the other hand when, as in unclean milk, an acid is present before contact with the renin, some of the casein unites with the acid (in this case lactic) to leave a free casein. This casein is tougher and less digestible than paracasein, and when this indigestible substance enters the stomach it unites with the free HCl to form tough leathery masses of casein hydrochloride which are not infrequently seen in the vomitus of babies but which more often pass into the intestine where they are as indigestible irritants and finally appear in the stool as curds. Clinically of course, in such cases it would be an error to assume a too great proteid concentration as the cause of these curds or to further dilute the milk until after an investigation and demonstration of its cleanliness or uncleanliness. And yet this is one of the most common errors to which we who feed infants are liable.

The difficulties which may follow the indigestion of fats are too varied and com-

plex to admit of complete discussion. The differences between the fat of human and of cow's milk, chemical and physical, quantitative and qualitative, are marked; and to obtain a mixture of cow's milk in which the fats will be in proper proportion and at the same time be digestible is extremely difficult. Within the infant body tissues rich in fat are being built up—bone marrow, nervous system and the subcutaneous fat which is so essential to prevent heat loss through radiation. The infant then demands at least 2 per cent of fat in order to maintain its healthy growth. Chemically, cow's milk fat contains much less olein and much less soluble fatty acids than human milk, while its phosphorus containing fat is only half so great as in the human variety. Because of mechanical differences chiefly through its high melting point, and because it inhibits the secretion of hydrochloric acid, stomachic digestion is interfered with and so proteid curds may appear in the stools. Some authors call these fatty, but Shaw of Montreal has shown by analysis that they contain only twenty per cent of fat and that this twenty per cent is distributed on the outside of the masses, the interior being undigested proteid.

Holt has called attention to what is now well known as "a scrambled egg stool," which is voided a variable number of times daily and contains in addition to mucus, bile and a very high percentage of fat, undigested proteids. This is simply such a stool as is caused by any irritant purgative. On investigation, it has invariably been shown that the child so affected was ingesting an inordinate amount of fat; and when this error had been rectified the condition was at once ameliorated. To a less degree a correct percentage of milk fat which had become stale and undergone some bacterial hydrolosis will produce the same effect. So we may have proteid curds in the stools due either to the mechanical or chemical action of fat in the food, and we would be no more justified in reducing the proteid here without further investigation than we would have been in the case of unclean milk. In the first instance the change to another milk is indicated; with no improvement or when the chemical effect of fats has been shown to be the cause of the trouble, a decrease in the fat percentage is indicated. Here the caloric plan comes to our aid, for by a few moments' work we are enabled to calculate a mixture in which the carbohydrates will supply a number of calories equal to those we have abstracted by reducing the fat percentage. The sugars are so uniformly utilized that it makes little difference whether we use cane, milk or malt sugar in our mixtures. My clinical experience is that cane sugar is more generally useful than milk or malt sugar, except in atrophics when malt sugar is undoubtedly the best so long as it is tolerated. Unfortunately it often leads to diarrhea and may, therefore, have to be discontinued. Milk sugar I only use in those cases in which cane sugar in percentages below five leads to loose green acid excoriating stools. Dextrins afford a carbohydrate source of energy easily digestible and entirely available and may be cheaply prepared at home, by browning domestic flours. So made, they carry small percentages of vegetable proteids of which we must take cognizance. Most of the popular proprietary foods are largely starch, malt sugar or dextrins with or without dried milk. They are objectionable chiefly because they are expensive and are dishonestly advertised. They have no advantage over sugar or cereal gruels combined with cow's milk except their convenience, which is doubtful, and any physician who prescribes them is doing himself and his profession a disservice.

Chapin has shown that it is easy to determine the percentage composition of gruels and it follows that it is equally easy to find their equivalent caloric values. In conclusion I would say that, thanks above all to Chapin, we have a simple method of preparing percentage mixtures. Armed with a bottle of milk and a Chapin dipper, the most stupid woman cannot fail if properly directed, to prepare sufficiently accurate mixtures. Chapin's book is accessible to every one and should be the infant feeder's bible. I will recall to you, that he uses top milk diluted with sugar water or gruel.

On the accompanying leaflet I have shown that the same percentages of proteid are always present in the same dilutions of a standard milk and that the proportion of proteid may be accurately and conveniently expressed in terms of dilution as of percentage. You will notice that a mixture 1-7 milk equals approximately $\frac{1}{2}$ per cent proteid. This is the most useful dilution to use when beginning substitute feeding. The concentration of the food should then be rapidly increased until the nutritive needs of the child, *plus the extra work necessary to digest the foreign albumen of cow's milk,* are fully met.

In practice the dilutions best tolerated are 1 to 3 at two months; 1 to 2 at four to five months; 1 to 1 at six months; 2 to 1 at nine months. By using the top milk, the fat percentages can be readily varied while the proteid percentage is maintained. It is a simple matter if we find fat too high to order more milk dipped off the bottle.

One class of ingredients essential to any nutritive mixture, the salines, we cannot measure in calories. While we know that they are essential to the utilization of proteids and for the building of blood, bone and muscle, we are ignorant of the percentages in which they are most useful. However, there is one helpful fact, developed by Hart and Van Slyke; namely, their demonstration that casein and paracasein compounds are soluble in dilute sodium-chloride solution. For many years clinicians have known that the addition of common salt (a drachm to 20 ounces of nutritive mixture) renders milk curd much more friable and digestible. (Jacobi and Eustace Smith.) So efficient is this simple maneuver that since I have been using it, I have failed to find the child who could not readily digest cow's milk mixtures, *provided they were made from clean milk,* and presented proper caloric values and percentage proportions.

If the views of Englander prove to be correct (which is doubtful) the citrating of milk warmly advocated by Poynton, Shaw and Cotton, (which I used for a number of years following Poynton's original recommendation and abandoned) is in effect but the addition of sodium chlorides to the digesting food. Englander thinks that the citrate of soda reacts with the hydrochloric acid in the stomach and so produces sodium chloride. Chapin believes that the citrate prevents clotting by the renin in the stomach and throws the work of digestion entirely on the intestine. This is probably the true view as we know that the citrates reduce the ionization of calcium and therefore its chemical activity, and it is a proven fact that the activity of calcium is essential to renin action.

To sum up then, successful infant feeding depends on: 1—Clean milk. 2—A simple modification plan which we have ready to hand in Chapin's top milk scheme. 3—A control of digestion through an understanding and application of the percentage proportion plan. 4—A thorough grasp of the infant's nutritive needs measured in calories. 5—An application of the laws of hygiene to the infant's environment.

A Simple Method of Computing, Approximately, Percentages of Proteid, Fat or Carbohydrate in Milk Mixtures, Based on Analysis of San Francisco Milk.

	Whole Milk.	Top 9 oz. dipped from 1 quart after 4 hours' standing.	Top 15 oz. Same Conditions.	Top 20 oz. Same Conditions.
Proteid	3.5%	3.5%	3.5%	3.5%
Fat	3.4%	10%	7 %	5 %

Fat values of all milks should be known before beginning their use.

To find % of proteid in any dilution divide % of proteid in whole milk by the denominator of the fraction representing the proportion of milk in mixture—i. e., in a mixture ⅛ milk divide $\frac{3.5}{8} = .44\%$ proteid.

A dilution of 1 to 6 = 1-7 milk; proteid % = $\frac{3.5}{7}$ = 5% proteid in mixture.

A dilution of 1 to 5 = 1-6 milk; proteid % = $\frac{3.5}{6}$ = 6% proteid in mixture.

A dilution of 1 to 4 = 1-5 milk; proteid % = $\frac{3.5}{5}$ = 7% proteid in mixture. And so on.

To find % of fat in any dilution of milk, divide % of fat in milk used by denominator of fraction representing proportion of milk in mixture. With 9 oz. top milk containing 10% fat.

1-7 milk = $\frac{10}{10}$ = 1.4%; 1-5 milk = $\frac{10}{7}$ = 2%; 1-3 milk = $\frac{10}{3}$ = 3.3%

3 to 3½% is the maximum concentration of fat desirable. When this is reached with 9 oz. milk change to 15 oz. top milk.

15 oz. milk = 7% fat; 1-3 milk = $\frac{7}{3}$ = 2.3.

20 oz. milk — 2-3 milk = 5% x $\frac{2}{3}$ = $\frac{10}{3}$ = 3.3% fat.

Sugar per cents in dilution are practically the same as proteid.

1 oz. of sugar to 20 oz. of mixture = 5% sugar; with a dilution of 1 to 5 sugar = .7, add 5% or any other % required.

To Compute Food Values of Percentage Mixtures.

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(1) A calorie is the amount of heat necessary to raise 1 kilogram (2 1-5 pounds) of water through 1° centigrade.

(2) A child during the first three months needs 40 calories per pound per day; in the second three months, 36 to 38 calories; and in the second half year, 30 to 35 calories.

(3) During the first three months a child will lose weight if supplied with less than 30 calories per pound per day.

(4) 1 gram of animal proteid = 4.1 calories.
1 gram of carbohydrate = 4.1 calories.
1 gram of fat = 9.3 calories.

(5) 1000 grams = 1 litre = a 1% solution = 10 grams to litre.

(6) 29.51 grams = 1 oz. ∴ 1 litre = in oz. $\frac{1000}{29.51}$ say = 33.93 oz. = 34 oz. to litre.

Assume a modified milk, containing proteid 1¼%, carbohydrate 5%, fat 3%—one litre of such a mixture would contain:

Carbohydrate 5 x 10 = 50 grams.
Proteid 1¼ x 10 = 12½ grams.
Fat 3 x 10 = 30 grams.

50 grams of C. H. = in calories 50 x 4.1 = 205 calories.

12½ grams of proteid = in calories 12½ x 4.1 = 50 calories.

30 grams of fat = in calories 30 x 9.3 = 279 calories.

Food value of 1 litre of the mixture..........534 calories.

To find what daily amount of the above mixture will supply the nutritive needs of a normal 15-pound baby five to six months old:

Calories needs per pound per day = 38.
x baby's weight in pounds = 15 = 15 x 38 = 570.
570 calories needed per day.

1 litre of the mixture gives 534 calories, or 36 calories short of enough for a 15-lb child.

If 34 oz. = 1 litre, and 1 litre = 534 calories, the calories in 1 oz. will = $\frac{534}{34}$ = 15.7 calories to each oz.

Then calories needed by child 570 divided by calories in 1 oz. of the mixture 15.7 = $\frac{570}{15.7}$ = 36 1-3 oz.—amount of this mixture required daily by child.

Practically 570 = 36 — or 6 daily bottles of 6 oz. each.